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QUANTIFICATION OF THREATS AND SUGGESTED AMELIORATIVE MEASURES FOR THE CONSERVATION OF THE CRITICALLY ENDANGERED JERDON'S COURSER *RHINOPTILUS BITORQUATUS* AND ITS HABITAT

Panchapakesan Jeganathan[1,5], Asad R. Rahmani[1,6], Rhys E. Green[2], Ken Norris[3],
Ioannis N. Vogiatzakis[3], Chris Bowden[4] and Debbie Pain[4]

[1]Bombay Natural History Society, Hornbill House, S.B. Singh Road, Mumbai 400 001, Maharashtra, India.
[2]Conservation Science Group, Department of Zoology, Downing Street, Cambridge, CB2 3EJ, UK.
Email: reg29@hermes.cam.ac.uk
[3]Centre for Agri-Environmental Research, School of Agriculture Policy and Development, University of Reading,
Earley Gate RG6 6AR, Reading Berks, UK.
[4]Royal Society for the Protection of Birds, The Lodge, Sandy, Bedfordshire, SG19 2DL, UK.
[5]Email: pnagej@gmail.com
[6]Email: bnhs@bom3.vsnl.net.in

Jerdon's Courser *Rhinoptilus bitorquatus* is a nocturnally active cursorial bird that is only known to occur in a small area of scrub jungle in and around Sri Lankamaleswara Wildlife Sanctuary, Cuddapah district, Andhra Pradesh, India, and is listed as Critically Endangered by the IUCN. Jerdon's Courser prefers a specific type of scrub jungle with open areas, and there is considerable pressure from human use of apparently suitable habitats. Although major threats to the survival of the Jerdon's Courser have been indentified, there is no quantitative information available. During our study, nine specific threats were identified to the survival of the Jerdon's Courser and its habitat. Habitat destruction and alteration is the major threat among them. However, the immediate threat for the only known population of the Jerdon's Courser in the world and its habitat is the construction of the Telugu-Ganga Canal near Sri Lankamaleswara Wildlife Sanctuary and Sri Penusula Narasimha Wildlife Sanctuary. The presence of the Jerdon's Courser was detected in three new locations in and around the Sri Lankamaleswara Wildlife Sanctuary, and one of these sites was destroyed due to the canal construction. There is an urgent need to save the scrub jungle habitat in and around the sanctuaries. We suggest several ameliorative measures for the conservation of the Jerdon's Courser and its habitat.

Key words: Jerdon's Courser, *Rhinoptilus bitorquatus,* conservation issues

INTRODUCTION

Jerdon's Courser *Rhinoptilus bitorquatus* is a nocturnal cursorial bird which is categorised as Critically Endangered in the IUCN Red List (BirdLife International 2001) since it is believed to have a single, small, declining population. It is listed under Schedule I of the Indian Wildlife (Protection) Act 1972 and is considered as a priority species under the National Wildlife Action Plan (2002-2016) of the Government of India (Government of India 2002). Although reported from other sites in the 1980s (Bhushan 1990), since that time it has only been reported from the small patch of scrub jungle in and around Sri Lankamaleswara Wildlife Sanctuary, Cuddapah district, Andhra Pradesh, India. Exploitation of scrub jungle habitat, livestock grazing and quarrying are the major threats identified so far to the Jerdon's Courser (Birdlife International 2001). Bhushan (1990) stated that major threat for the Jerdon's Courser and its habitat was the collection of minor forest produce such as fuel wood and timber by the local villagers in and around the Sri Lankamaleswara Wildlife Sanctuary. However, there is no comprehensive study to identify and to quantify the specific threats to this critically endangered bird and its habitat. In this paper we have discussed the recent threats faced by the Jerdon's Courser and its habitat.

STUDY AREA

This study was conducted from September 2000 to December 2005 in scrub jungle in the Sri Lankamaleswara and Sri Penusula Narasimha wildlife sanctuaries, in Cuddapah district, Andhra Pradesh (Fig. 1). The forest type in the main study area is defined as southern tropical thorn scrub (Champion and Seth 1968). The major vegetation in the scrub forest consists of *Acacia* spp., *Ziziphus rugosa* and *Carissa carandas*, and the major tree species are *Hardwickia binata* and *Anogeissus latifolia*. The scrub jungle is bordered by dry mixed deciduous and Red Sanders-bearing forest consisting of *Pterocarpus santalinus, Terminalia chebula* and *T. tomentosa.* There are patches of dry savannah forest consisting of *Anogeissus latifolia* and *Phyllanthus emblica.* Generally hot weather prevails throughout the year in the study area. Records for Cuddapah from 2001 to 2004 show that the mean monthly daytime temperature ranges between 17.1 °C in December and 42 °C in May. Cuddapah is one of the drought-prone districts of Andhra Pradesh, and the average rainfall for 50 years (1901-1950) was 744 mm (Jagannadha Sarma 2002).

Sri Lankamaleswara Wildlife Sanctuary

A major part of the study was carried out in and around

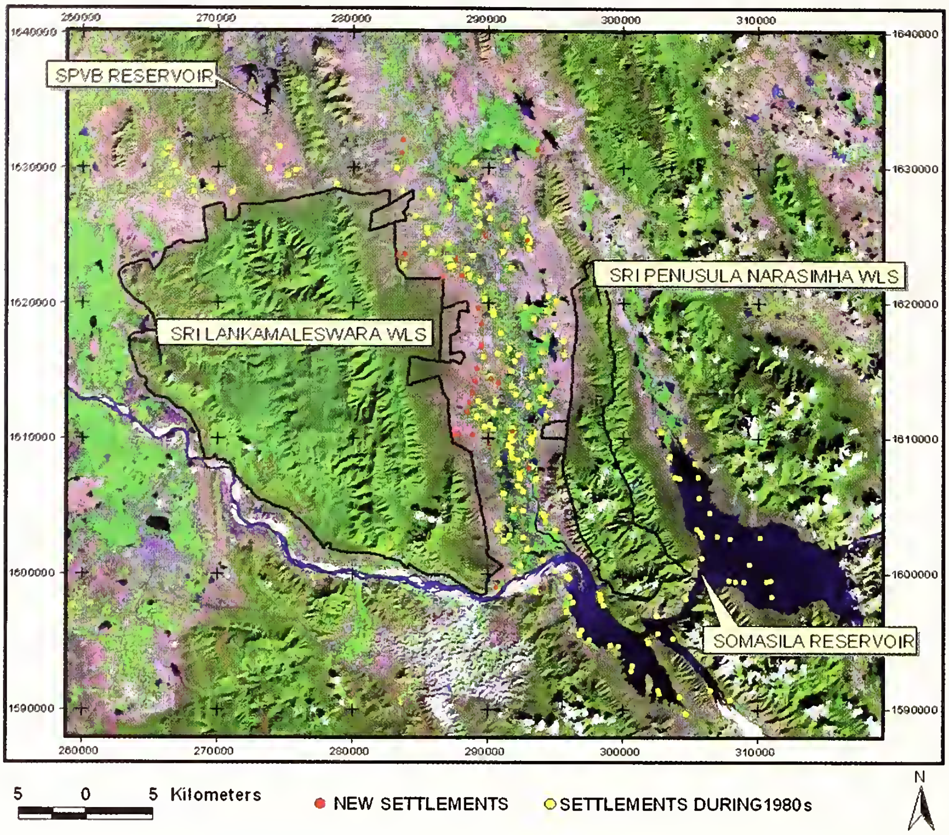

Fig. 1: Settlements near the Sri Lankamaleswara and Cuddapah Division of Sri Penusula Narasimha Wildlife sanctuaries Yellow dots: old settlements (during 1980s) are taken from Survey of India toposheets, and red dots: new settlements (formed within 10-15 years) mapped during this study. Map overlaid on Landsat 7 ETM satellite image (path/row 143/050) of December 06, 2000. (Co-ordinates are in UTM)

the Sri Lankamaleswara Wildlife Sanctuary (SLWLS), Cuddapah district, Andhra Pradesh, India. Geographically, SLWLS lies between the Nallamalais and the Sechachalam hill ranges in the central part of the Eastern Ghats. SLWLS extends over 464 sq. km and is located between 14°45'-14°72' N and 79°07'-78°80' E. The Sanctuary ranges from about 137 m to 784 m above mean sea level in elevation (Fig. 1). The study area was bordered in the west by dense scrub and dry Red Sanders-bearing forest as well as southern dry mixed deciduous forests on the higher elevations of the Lankamalai Hills. To the east, agricultural fields, orchards and croplands are found in the valleys of the semi-perennial Sagileru river. Sagileru joins the Pennar river, which borders the southern part as well as a part of the western side of the Sanctuary (Fig. 1).

Sri Penusula Narasimha Wildlife Sanctuary

Sri Penusula Narasimha Wildlife Sanctuary (SPNWLS) spreads across the districts of Cuddapah and Nellore, Andhra Pradesh (14°18'-14°41' N; 79°05'-79° 37' E). SPNWLS is adjacent to the SLWLS region and covers 1,031 sq. km (Fig. 1). This area encompasses the Turupukonda Hills, part of the Velikonda hill ranges, Somasila dam and Kandaleru reservoir. SPNWLS is separated from SLWLS by the River Sagileru. This study was conducted mainly on the western slope of the Turupukonda Hills for about 6 months in the scrub jungle habitat. This place is accessible from the eastern part of the SLWLS and falls within Cuddapah district. The climate of SPNWLS is similar to that of the SLWLS region. The vegetation and forest types do not differ much from those of SLWLS at least in the western part this Sanctuary. Moist deciduous forest and dry thorn forest are present at the foothills of the Velikonda hill ranges.

METHODS

Disturbance of the scrub jungle habitat from anthropogenic activities such as livestock grazing were documented near the Sri Lankamaleswara and Sri Penusula Narasimha wildlife sanctuaries from 2000 to 2005. The

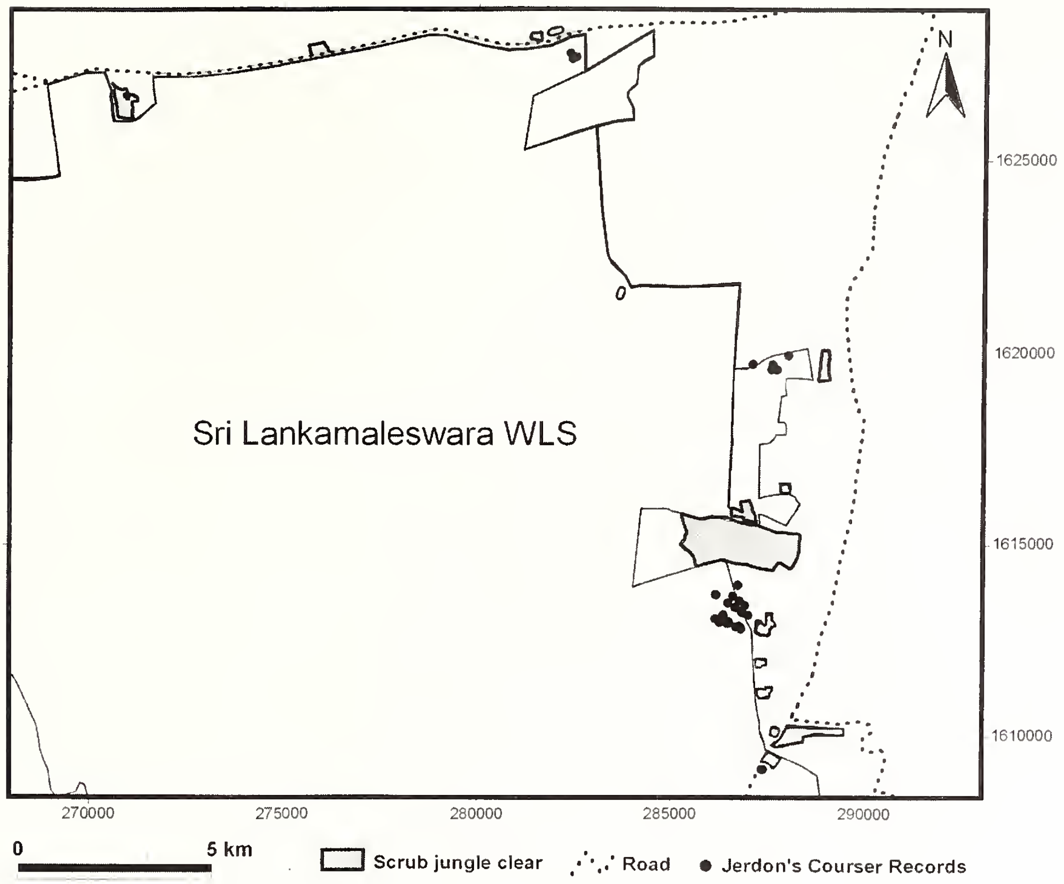

Fig. 2: Scrub jungle clearance and Jerdon's Courser records in and around Sri Lankamaleswara Wildlife Sanctuary (Co-ordinates are in UTM)

presence of Jerdon's Coursers was detected by playing tape recordings to elicit calls (Jeganathan and Wotton 2004) and following the tracking strip method (Jeganathan *et al.* 2002). Tracking strips were placed in the eastern part of Sri Lankamaleswara Wildlife Sanctuary and in the western part of the Turupukonda forest, which is situated in the Cuddapah part of the Sri Penusula Narasimha Wildlife Sanctuary, and on the western side of the Velikonda hill ranges. Tree and bush species were counted and identified, and the substrates and ground vegetation described within 10 x 10 m plots at the locations of tracking strips. By relating the rate of tracking of the Jerdon's Courser to these habitat traits, the preferred habitat of the Jerdon's Courser was identified as scrub jungle with open areas where the density of large bushes (> 2 m tall) is in the range 300 - 700 per ha and the density of small bushes is < 1,000 per ha (Jeganathan *et al.* 2004).

Scrub jungle with open areas, which are potentially suitable habitat of the Jerdon's Courser were cleared and developmental activities took place in and around the Sanctuary areas during the study period. The Telugu-Ganga Canal was constructed in and near the Sanctuary areas during October 2005. All anthropogenic activities were recorded, and the places where such activities occurred were marked using a GPS. The potentially suitable habitat of the Jerdon's Courser was mapped with the help of satellite imagery (Jeganathan *et al.* 2005). The extent of the area cleared was mapped by walking along the edge with a GPS. A map of the cleared areas was kept as an overlay on the potentially suitable habitat of the Jerdon's Courser to find out the extent of the habitat loss. This was achieved with the help of ERDAS imagine 8.5 and Arc View GIS 3.2a software.

Instances of livestock grazing were established using the footprints of goats, sheep and buffalo on tracking strips and the rate of tracking was calculated. The number of households and the cattle population were determined in November 2005 by interviewing locals from the 14 villages around the northern and eastern boundaries of the Sri Lankamaleswara Wildlife Sanctuary.

The amount of wood cut was quantified by noting the scrub and tree species cut in the 10 m square habitat recording plots. Totally 294 plots were surveyed in and near the Sri Lankamaleswara and Sri Penusula Narasimha wildlife sanctuaries, as well as in the reserved forest areas of the Velikonda foothills. Apart from this, the extent of human use of these forest areas was quantified by calculating the rate of encountering head loads, cart loads and tractor loads of timber and non-timber forest produce (NTFP).

Threats to the Jerdon's Courser Habitat

Previously the presence of the Jerdon's Courser was only confirmed inside and near Sri Lankamaleswara Wildlife Sanctuary (Bhushan 1986). Through the tracking strip and tape playback survey it was detected in three new places.

Nine specific threats were identified to the survival of the Jerdon's Courser and its habitat. Habitat destruction and alteration is the major threat among them. However, the immediate threat to the only known world population of the Jerdon's Courser is the construction of the Telugu-Ganga Canal near the two sanctuaries.

1. Scrub jungle clearance for farming and plantation

An area of about 480 ha of the scrub jungle was cleared during the study period (2001-2004) in and around the Sri Lankamaleswara Wildlife Sanctuary. Of this, nearly 275 ha of the scrub jungle, which is potentially suitable for the Jerdon's Courser, was cleared to provide land for agriculture to people who were displaced by floods, and for lemon farming and forestry plantations. These cleared places fall within about 1 km from the previously known and newly detected Jerdon's Courser areas (Fig. 2). Scrub jungle habitat was cleared inside the Sri Lankamaleswara Wildlife Sanctuary mainly for raising forestry plantations consisting of *Pongamia pinnata, Terminalia arjuna, Cassia siamea, Eucalyptus* sp. and *Syzygium cumini.* Analysis of Landsat satellite imagery showed that the clearance of scrub jungle in this region has been happening before the beginning of our field study in 2000. Analysis of satellite images show that between 1991 and 2000 11-15% of the scrub jungle has been cleared, especially close to human settlements (Senapathi *et al.* 2007).

2. Developmental activities inside the Sri Lankamaleswara Wildlife Sanctuary

Apart from the plantations, several other developmental activities such as the construction of check dams and digging of percolation ponds and trenches were noticed during the study period. It should be noted that trenches were dug in the places where the Jerdon's Courser has been seen regularly since its rediscovery in 1986. The trenches stretch over different lengths from 50 m to 1.3 km; they are 2 m deep, and the width varies from 2 to 5 m. The trenches were dug at intervals of 20 to 50 m. Five percolation ponds were constructed near the main Jerdon's Courser area during the study period. About 0.5 to 1 ha of scrub jungle was cleared for each pond and an earthen bund was constructed by piling up the soil dug for the pond. On the bund, exotic plant species were planted. Apart from this, in the scrub jungle habitat another type of forestry practice called thinning and singling was noted in which all the scrub species were cleared except the saplings (1-2 m in height) of tree species such as *Hardwickia binata, Anogeissus latifolia, Manilkara hexandra* and *Soymida febrifuga.* Later, circular pits were dug around these trees, which facilitates collection of rain water. Also, several small pits were dug for rain water collection in the cleared open areas where this thinning was carried out.

3. Quarrying in and around Sri Lankamaleswara Wildlife Sanctuary

Stones of different sizes present on the ground were collected for road construction every year from the scrub jungle habitat both in and outside Sri Lankamaleswara Wildlife Sanctuary. Apart from this, bigger stones below the ground were dug up using crowbars and broken into pieces and collected in heavy vehicles. These stones were collected for house construction by the nearby villagers. Large pits were dug up in about 15 places in and outside the eastern part of Sri Lankamaleswara Wildlife Sanctuary. However, no instance of using explosives for quarrying was noted during the study period.

4. Increasing number of settlements near the sanctuaries

Bhushan (1995) reports that the construction of the Somasila dam resulted in the displacement of 57 villages, which moved closer to Sri Lankamaleswara Wildlife Sanctuary. The construction of the Somasila dam was completed in 1989 (Nikku 2004). The locations of the villages near the study area were obtained from Survey of India toposheets, which were based on surveys conducted in 1986 prior to the construction of the Somasila dam. GPS locations of villages near Sri Lankamaleswara Wildlife Sanctuary were taken. These locations were plotted, and a map was produced. Village locations taken from the toposheets plotted on the Landsat ETM Satellite image of December 06, 2000 shows that nearly 45 villages were submerged under the Somasila reservoir (Fig. 1). There are about 146 villages present between the eastern part of Sri Lankamaleswara Wildlife Sanctuary and the western side of the Cuddapah Division of Sri Penusula Narasimha Wildlife Sanctuary. Of these 146 villages, 25 were formed in recent times (within 10 to 15 years). This was established by interviewing the local people from these villages. It should be noted that most of these villagers moved from the bank of the Sagileru river, which runs in-between Sri Lankamaleswara and Sri Penusula Narasimha wildlife sanctuaries. It was observed during the study period (from 2000 to 2005) that Sagileru river was flooded three times in the rainy season. Villagers near the bank of the Sagileru river moved towards the west, near the Badvel-Siddavatam road, which is about 2 km away from the eastern boundary of Sri Lankamaleswara Wildlife Sanctuary.

Besides this, about 15 villages were displaced due to the construction of Sri Potuluri Veera Brahmendraswamy (SPVB) Reservoir in the place called Bramhamgarimatam, which is about 12 km north of Sri Lankamaleswara Wildlife Sanctuary (Fig. 1). Twelve villages are present within 1 km from the northern boundary of Sri Lankamaleswara Wildlife Sanctuary, of which seven villages were resettled due to the construction of the SPVB reservoir near the Badvel-Mydukur, which partly forms the northern boundary of this Sanctuary.

It should be noted that there are even more villages in the flood-prone area of the Somasila and SPVB reservoirs which are likely to be resettled near the sanctuaries in the future. Also, there are plans to increase the height of the Somasila dam, which will result in the displacement of more villages to areas near the south-eastern part of Sri Lankamaleswara Wildlife Sanctuary.

5. Agricultural transformation

The major crops around Sri Lankamaleswara and Sri Penusula Narasimha wildlife sanctuaries are Paddy *Oryza sativa*, Sunflower *Helianthus annuus*, Cotton *Gossypium* sp., Groundnut *Arachis hypogaea*, Finger Millet *Eleusine coracana*, Turmeric *Curcuma longa* and Onion *Allium cepa*. However, in recent times, several agricultural fields have been transformed into Lemon farms. Species such as Lemon *Citrus limon*, Bitter Lime *Citrus aurantium*, Sweet lime *Citrus sinensis* and Key Lime *Citrus aurantifolia* are grown since they need relatively little water and maintenance, and are lucrative. This agricultural transformation, from dry irrigated crops to lemon farms, was mainly due to erratic and failed seasonal rains. Lemon farms present near the eastern part of Sri Lankamaleswara Wildlife Sanctuary were mapped in June 2004. Farms extend to about 1.5 km on either side of the Badvel-Siddavatam road. The extent of the lemon farms in this region was calculated to be 198 ha. It should be noted that about 215 ha of scrub jungle habitat was cleared outside the Sanctuary from 2000 to 2005 (Fig. 2). Most of these clearance were not yet cultivated and are most likely to be converted into lemon farms in future.

6. Livestock grazing

Three types of livestock grazing were observed in and around Sri Lankamaleswara and Sri Penusula Narasimha wildlife sanctuaries. In the first type, shepherds brought their goats, sheep and buffalo regularly every morning from the villages into the scrub jungle habitat in and around the sanctuaries. The animals stray inside the forest for about 2-3 km and return to their villages in the evening. Another type are nomads who possess 200 to 300 cattle. They rear only cows. However, these are not for milk but mainly for the cow dung. They were generally invited by the lemon farm owners to enrich their farms. The graziers stay up to 3 to 4 months in one place before moving to another. All these cattle were seen grazing in the forested areas in and around the sanctuaries. The third type stays with their sheep inside the sanctuaries for grazing throughout the year except during the rainy season. However, this type of grazing was not observed in the scrub jungle habitat.

Tracking strips (a total of 410) were deployed in and around Sri Lankamaleswara and Sri Penusula Narasimha wildlife sanctuaries as well as in the reserve forest areas of the Velikonda foothills in 24 blocks. Each block consists of 15-20 tracking strips, usually placed in a regular rectangular or square array. While recording bird footprints in the tracking strips, tracks of goats, sheep and buffalo were also recorded. Footprints of human beings observed in the tracking strips were also recorded. The tracking rate of the cattle and human beings was relatively higher than that of the wild ungulates present in the study area. Goats and sheep tracked were found on 78.5% of the tracking strips. Buffalo and human tracks were recorded in 47% and 72% of the tracking strips, respectively. Details of the tracking events of cattle and humans in the 24 blocks of tracking strips are given in Table 1.

Data on the cattle population and number of households were collected in November 2005 from 14 villages situated in the eastern (10 villages) and northern (four villages) parts of the Sri Lankamaleswara Wildlife Sanctuary. The goat and sheep populations were higher (38% and 36% of the total population, respectively) than that of buffalo (23%). The total number of households recorded in these villages was 1,684. The largest number of households was recorded in Reddipalli (300 households), which is close to the main Jerdon's Courser area. The cattle population exceed 1,000 in three of the villages surveyed (Fig. 3).

7. Use of forest by the villagers

During field visits to the Sri Lankamaleswara and Sri Penusula Narasimha wildlife sanctuaries, the removal of timber and non-timber forest products from the forest area by head loads, cart loads and tractor loads was noted from 2001 to 2003. It should be noted that these observations include encounters with fuel wood, wood collected illegally, grass, bamboo and other non-timber forest produce (NTFP). Most of the NTFP, fuel wood, fodder leaves for cattle and single large timbers (DBH approximately 60 to 80 cm) of *c.* 2-3 m length were carried by head loads whereas large quantities of timber, fodder leaves and grass were carried either by bullock cart or by tractor. Such events were noted only if they were seen on the forest roads. Although several hundred visits were made to the field, these events were studied only during 256 visits (Table 2). It should be noted that the data collection was not very systematic, as only opportunistic data was collected. Of the 256 visits, these events were encountered on 65% of the total visits. The mean encounter rate of head loads was highest (0.49 ±0.06 per visit), followed by cart loads (0.21 ±0.1 per visit) and tractor loads (0.15 ±0.05 per visit) (Fig. 4).

In the scrub jungle habitat, wood cutting was observed regularly. Mainly *Hardwickia binata* was pollarded during summer for thatching above the front door of houses. Also graziers cut and bend the branches of scrub and tree species to facilitate better access for browsing by goats and sheep, inside the scrub jungle. While recording the habitat in a 10 m square plot centred on the tracking strips, on a total of 294 plots surveyed, and cut marks in 28 scrub and tree species were noted. The maximum of cut marks was observed in *Zizyphus rugosa* (39% of the plots surveyed). Only 8% of plots surveyed had no cut marks (Fig. 5).

Table 1: Tracking rates of goats and sheep, buffalo and humans in 24 blocks of tracking strips deployed in and around Sri Lankamaleswara and Sri Penusula Narasimha Wildlife sanctuaries and in the reserved forest areas of Velikonda foothills from 2000-2003

Block	Tracking strip nights	Tracking rates		
		Goats and Sheep	Buffalo	Human
JC1&2	863	0.023	0.001	0.043
P1S	421	0.007	0	0.014
B1	112	0.071	0.009	0.009
B2	238	0.151	0	0.059
B5	458	0.076	0.114	0.020
B3	477	0.042	0.075	0.034
B9	435	0.092	0.177	0.053
B6	231	0.074	0	0.022
B11	555	0.072	0.020	0.016
HS1-16	756	0.050	0.009	0.029
HS17-27	684	0.029	0	0.035
HS28-39	247	0.016	0	0.053
B8	499	0.150	0.130	0.074
B4*	459	0.083	0.087	0.061
B7	460	0.167	0.209	0.061
B13#	462	0.115	0.149	0.082
B14#	454	0.097	0.099	0.066
B10*	387	0.090	0.111	0.041
B12#	484	0.025	0.010	0.039
B15	471	0.110	0	0.021
B18	465	0.110	0.015	0.009
B17	512	0.068	0	0.012
B19	238	0.151	0	0.059
B20	207	0.053	0.068	0.058

8. Bird trapping

Illegal bird trapping by a particular section of people in the peripheral areas of the eastern part of Sri Lankamaleswara Wildlife Sanctuary was noticed on a few occasions only (<5 encounters on several hundred field visits in four years). It should be noted that on one occasion, a bird trapper was seen near the main Jerdon's Courser area. Traps used by these trappers are nooses and nets. They mainly target Grey Francolin *Francolinus pondicerianus* and Quail spp., which commonly occur in this area. Although trapping, exclusively for the Jerdon's Courser was not reported, it is likely that it maybe caught accidentally in the nooses and nets set for other bird species.

9. Telugu-Ganga Canal

At the time of the rediscovery in 1986, the Jerdon's Courser site was under threat from a plan to construct the Telugu-Ganga Canal across it. Officials from the Forest Department and the State Government of Andhra Pradesh recognised the ornithological importance of the area and declared it as Sri Lankamaleswara Wildlife Sanctuary for the Jerdon's Courser, which included the rediscovery site on its eastern fringe. The proposed course of the canal was adjusted to avoid the Sanctuary (Bhushan 1995). Recently canal construction was started for irrigating land in Sagileru valley. The canal construction was noticed during the last week of October 2005 near Sri Lankamaleswara Wildlife Sanctuary. The origin of the canal is from SPVB (Sri Potuluri Veera Brahmendraswamy) Reservoir near Bramhamgarimatam (Fig. 1). This canal comes southwards and ends 2 km away from Nandhipalli near the Badvel-Mydukur road. It is also referred as the Right Canal. Apart from this, one more canal is being excavated southwards to the east of the Sagileru river, and it goes along the western boundary of Sri Penusula Narasimha Wildlife Sanctuary (Fig. 6). This part of the

Table 2: Observation of collection of forest produce from Sri Lankamaleswara and Sri Penusula Narasimha wildlife sanctuaries from 2001 to 2003

Year	Head load	Cartload	Tractor load	*n*
2001	22	9	9	43
2002	81	31	22	158
2003	22	12	6	55
Total	125	52	37	256

n: number of visits

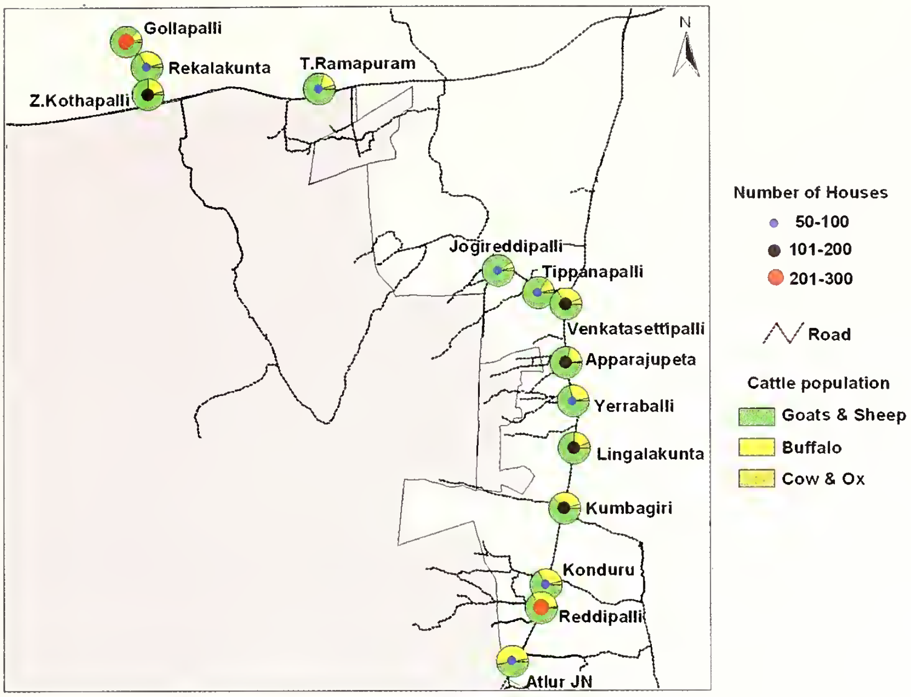

Fig. 3: Number of households and cattle population in 14 villages situated within 2 km from the eastern and northern boundaries of the Sri Lankamaleswara Wildlife Sanctuary. (Map not to scale)

Sanctuary falls under the Cuddapah Forest Division. This canal is referred as the Left Canal. Both the canals were stopped as they were constructed in the forest areas without obtaining prior permission (Jeganathan *et al.* 2005).

The canal route and disturbances noted while constructing the canal, such as new roads to the canal sites and quarrying soil for canal construction in the forest area were documented from November 21 to 28, 2005. The canal was 16 to 20 m wide, but the area cleared for preparing this canal was 80 to 100 m wide. Stones and the soil were dug up and piled all along the canal route. Roads were constructed on either side of the canal using this soil as well as soil dug up from nearby areas.

The canal route was mapped with the help of a GPS by driving the jeep along it and/or walking on it. Tracks of the canal route and other coordinates marked in the field were converted to Arc coverage format. On the screen, simulated lines were drawn on either side of the canal tracks for not less than 40 m to mark the width of the area cleared. This was marked as a polygon and the area was obtained. It should be noted that the area falling inside this polygon has different kinds of habitats such as open ground, rocky terrain and scrub jungle. This coverage was kept as an overlay on a map of potentially suitable habitat of the Jerdon's Courser to find out the habitat loss. Where there was a forest cleared with no canal, it was mapped by walking along the forest

Table 3: Sri Lankamaleswara Wildlife Sanctuary and Cuddapah Division of Sri Penusula Narasimha Wildlife Sanctuary*

Division	Block name	Block code	Compartment numbers
Proddatur	Chennamukkapalle Reserve Forest	19042	76, 77
	Lankamalai Reserve Forest	19043	79, 80, 85, 86, 89, 90, 91, 92, 97, 98
	Lankamalai Reserve Forest	19061	274, 275, 276, 277, 278, 279, 280, 281, 282, 283
	Gopalapuram Reserve Forest	19062	290
Cuddapah	Lankamalai Extension Reserve Forest	19079	376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 392, 394, 395, 396, 399
	Lankamalai Extension Reserve Forest	19080	400
	Lankamalai Reserve Forest	19080	418, 419
	Yerraballi Forest Block	19081	1171
	Turpukonda Extn Reserve Forest*	19077	365, 366, 367, 368, 369,370, 371,374
	Muthukuru Forest Block*	19082	1172

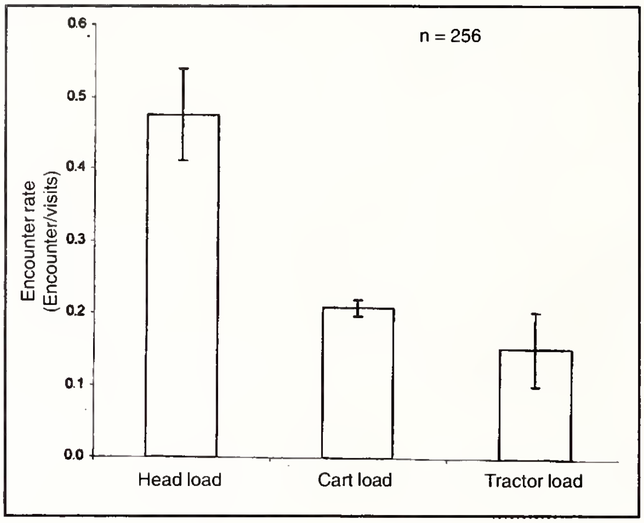

Fig. 4: Mean encounter rate of the observation of collection of forest produce by villagers around Sri Lankamaleswara and Sri Penusula Narasimha Wildlife Sanctuaries from 2001 to 2003

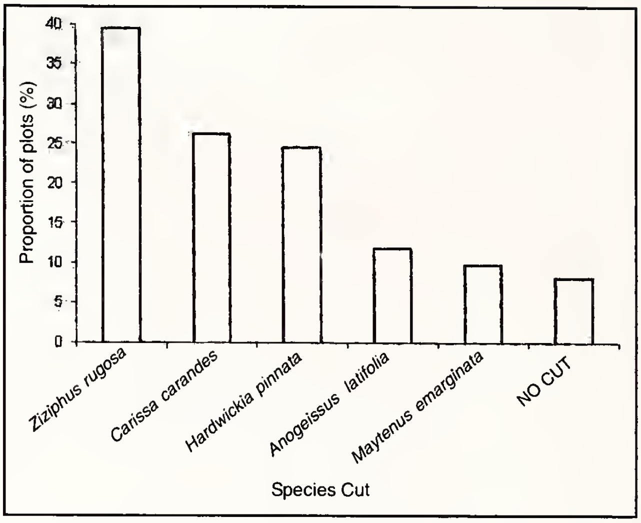

Fig. 5: Cut marks seen in top five scrub and tree species (10% to 40%) of the 294 10-m square plots surveyed. Percentage of plots that do not have any species is also given

clearing. So the width was not simulatend and the track itself was transformed into a polygon and the area was obtained.

The total area cleared estimated for the Right Canal is 114 ha, of which *c.* 22 ha of potentially suitable habitat for the Jerdon's Courser was lost due to the construction of the canal in the eastern part of Sri Lankamaleswara Wildlife Sanctuary. Construction work has also destroyed one of the places where the Jerdon's Courser was recorded in 2001.

The proposed route for the canal construction goes along the Sanctuary boundary and ends at 45 km from its origin near Atlur. Alarmingly, when this canal route reaches its 40th km it goes very close (about 500 m) to the place where the Jerdon's Courser has been sighted regularly from 1986. The scrub jungle in and around this area is the only place where Jerdon's Courser has been sighted frequently, its footprints obtained and its calls heard regularly. This is the only place in the world at the moment where the Jerdon's Courser is known to be present. It was estimated that if excavation for the proposed canal proceeds further, it would destroy *c.* 650 ha of suitable habitat of the Jerdon's Courser around Sri Lankamaleswara Wildlife Sanctuary.

The total area cleared estimated for the construction of the left canal in and around Sri Penusula Narasimha Wildlife Sanctuary is *c.* 163 ha. The forest area cleared is *c.* 8 ha. Further this canal route passes very close to the Sanctuary boundary. A large extent of favourable habitat is present at the foothills of Turupukonda.

DISCUSSION

The Jerdon's Courser uses a specific type of scrub jungle habitat for feeding and breeding. Studies show that the extinction risk of birds increases when habitat loss is severe, especially for habitat specialists (Owens and Bennett 2000; Norris and Harper 2004). The Jerdon's Courser possesses other traits which increase its extinction probability: small geographical range, small population size and occurring at a low elevation (Gaston 1994; Purvis *et al.* 2000; Gage *et al.* 2004).

Settlements near Sri Lankamaleswara Wildlife Sanctuary already pose a severe threat and more settlements in the future would worsen the threat as this would result in clearing of more scrub jungle habitat, increasing the livestock population and grazing, wood cutting and bird trapping. It should be noted that, out of the 14 villages surveyed around Sri Lankamaleswara Wildlife Sanctuary, the largest number of households and the largest livestock population were recorded in Reddipalli, which is near the main Jerdon's Courser area (Fig. 3). Increasing the number of households and the population around the Sanctuary would pave the way to intense use of the scrub jungle habitat.

Highly populated areas, especially in rural India, are likely to have higher livestock populations. The total livestock in Andhra Pradesh has increased from 36.01 million to 48.20 million between 1999 and 2003 showing an overall increase of 33.8 % (Government of India 2005). Increasing the number of settlements near the Sanctuary is likely to bring more livestock in the future as the livelihood of most of the

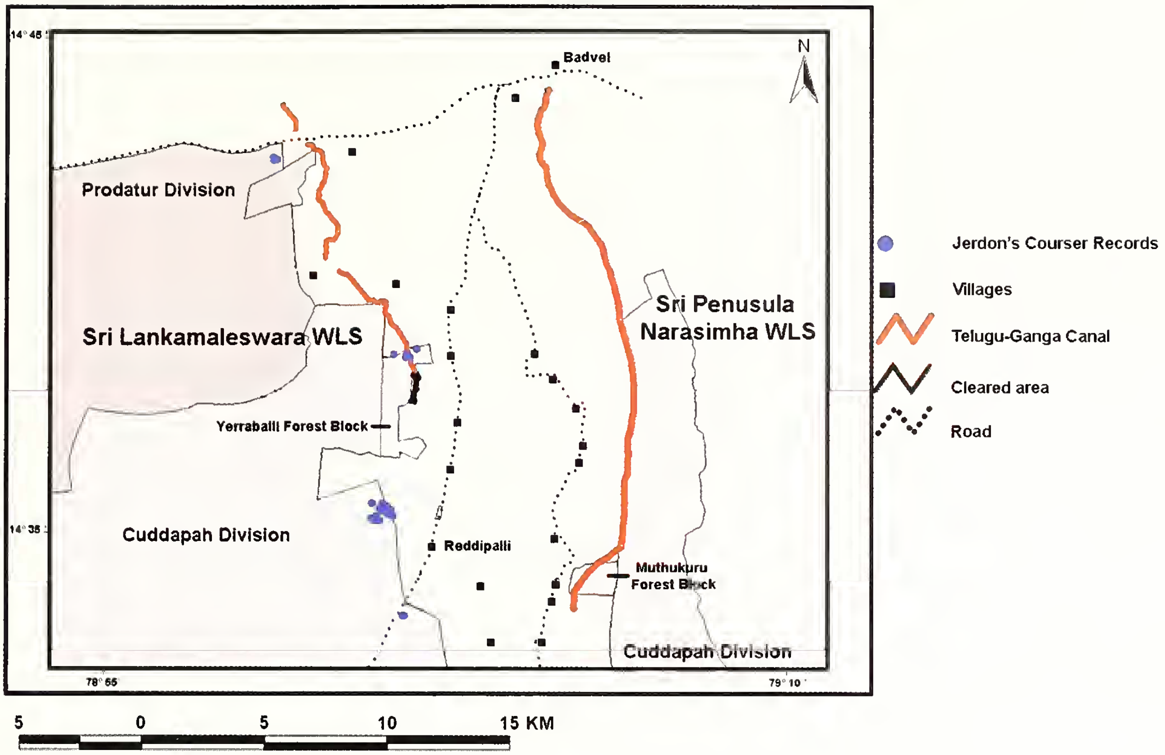

Fig. 6: Route of Telugu-Ganga Canal in and around Sri Lankamaleswara and Sri Penusula Narasimha Wildlife sanctuaries in Cuddapah district, Andhra Pradesh

villagers is cattle rearing, second to agriculture. In rural areas of India, the primary source of energy for cooking is fuel wood. The encounter rate of forest produces carried through head loads was higher compared with cart loads and tractor loads in this study. It should be noted that though the head load category consists of NTFP, grass and illicit wood, the frequency of head loads of fuel wood was greater than that of other forest produce.

Although a moderate amount of grazing and wood cutting would benefit in maintaining the structure of the scrub jungle habitat preferred by the Jerdon's Courser, over-grazing and intense human use would result in deterioration of the habitat.

Although an area covering 43,600 ha was declared as Sri Lankamaleswara Wildlife Sanctuary mainly for the Jerdon's Courser, only *c.* 15% of the land has scrub jungle habitat. Even though the Jerdon's Courser has been recorded at three new places, these are all within 15 km of the original rediscovery site. Most of the anthropogenic activities described above have been witnessed both in and outside the Sanctuary area. Intense human use, over-grazing and increasing number of settlements will surely have a gradual negative impact on the scrub jungle habitat. However, the immediate threat facing the scrub jungle habitat around Sri Lankamaleswara Wildlife Sanctuary is the construction of the Telugu-Ganga Canal. Although the 'Right Canal' has been stopped for the time being, it is estimated that if the canal had been continued, it would have resulted in the loss of *c.* 650 ha of scrub jungle habitat around the Sri Lankamaleswara Wildlife Sanctuary.

The new Telugu-Ganga Canal poses at least three types of threat to the Jerdon's Courser:

(1) Construction will destroy the remaining scrub jungle habitat of the Jerdon's Courser in the eastern part of Sri Lankamaleswara Wildlife Sanctuary. Furthermore, because the population survey work is at an early stage, other Jerdon's Courser sites where the species has not yet been detected will also be destroyed. This will further diminish the population. Absence of Jerdon's Courser records does not imply an absence of the bird, as most of the areas outside the Sanctuary have not been surveyed yet. Therefore, it is imperative to protect the potentially suitable habitat outside the Sanctuary.

(2) The Canal will permit the extension of irrigated agriculture to many areas outside the Sanctuary that are scrub jungle at present. Rapid replacement of forested landscapes by cultivated lands along with a change in cropping pattern has caused deterioration in the Jerdon's Courser's habitat.

(3) Extension of agricultural use will lead to increased human activity in and near the Sanctuary. In turn, this is likely

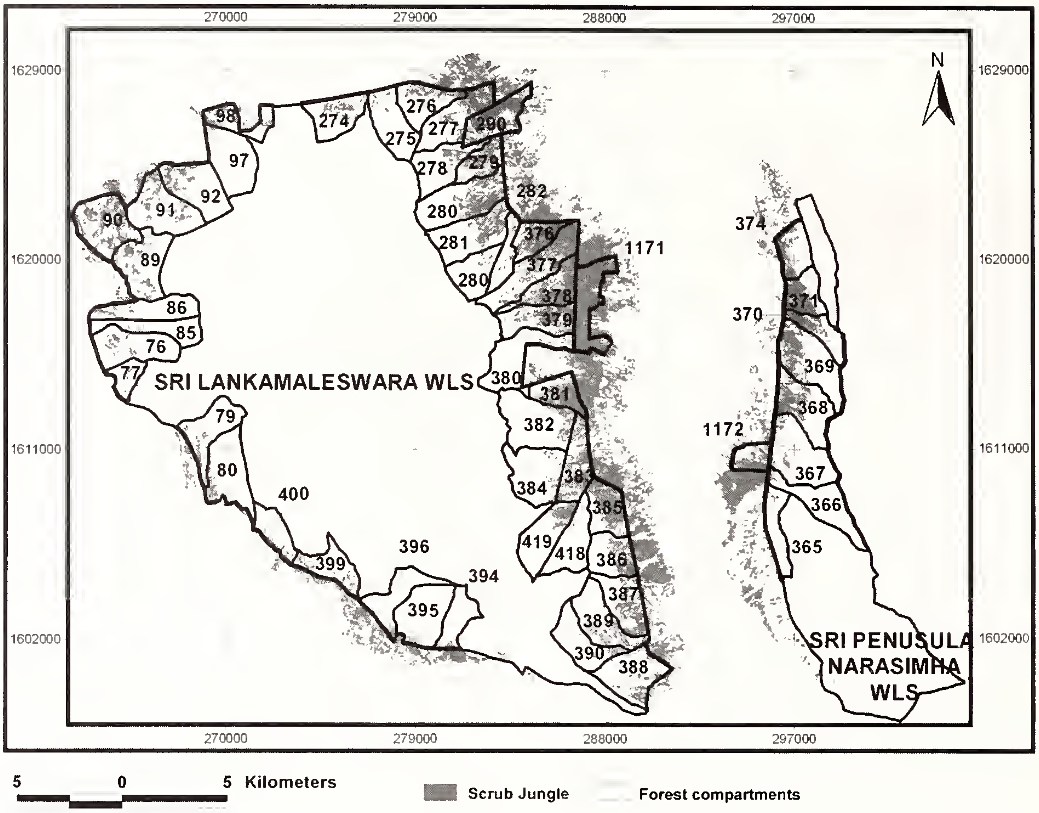

Fig. 7: Distribution of the scrub jungle habitat in and around the Sri Lankamaleswara and Sri Penusula Narasimha Wildlife sanctuaries. Forest compartment numbers in which the scrub jungle occurs are also given. (Co-ordinates are in UTM)

to increase unauthorised human use of the Sanctuary and any remaining scrub jungle outside it. All known Jerdon's Courser sites are already used for grazing of livestock and wood cutting, but at moderate levels, which may help to maintain a suitable vegetation structure for the Jerdon's Courser. However, increased use is likely to reduce the density of bushes below suitable levels for the species. Other unauthorised uses of the Sanctuary include hunting of mammals and bird trapping.

RECOMMENDATIONS

1. The Right Canal should be realigned near Sri Lankamaleswara Wildlife Sanctuary and diverted well away from the potentially suitable habitat of the Jerdon's Courser.

2. Areas west of the proposed Right Canal up to the boundary of the Sanctuary consist of potentially suitable habitat for the Jerdon's Courser. So this entire area should be included in the Sanctuary.

3. In and near the Sri Lankamaleswara Wildlife Sanctuary and Cuddapah Division of Sri Penusula Narasimha Wildlife Sanctuary, the scrub jungle habitat is distributed over nine Forest Blocks (in 55 compartments) as shown in (Fig. 7). Forestry activities such as construction of percolation ponds and trenches, and singling, thinning, and clearing the scrub jungle for planting exotic tree species should not be allowed in the Sanctuary and in blocks with suitable scrub jungle habitat owned by the Forest Department, but currently outside the Sanctuary boundaries. These areas are vital for the survival of the Jerdon's Courser.

4. Over-grazing should be controlled and illegal bird trappers around the Sanctuary should be identified, and measures should be taken to prevent hunting.

5. Before 2000, substantial numbers of foreign birdwatchers came to visit the area to see Jerdon's Coursers. They were guided by a local man and did no harm to the birds. This no longer occurs regularly, resulting in a loss of income from tourism in local villages. The scope for carefully controlled eco-tourism with the possibility of seeing or hearing Jerdon's Courser as the centrepiece should be investigated.

6. A species recovery plan for the protection of the Jerdon's Courser should be prepared based on scientific studies in and around the two sanctuaries and the reserved forests, including detailed plans for all the activities listed above.

REFERENCES

BHUSHAN, B. (1986): Rediscovery of the Jerdon's or Double-banded Courser *Cursorious bitorquatus* (Blyth). *J. Bombay Nat. Hist. Soc. 83*: 1-14.

BHUSHAN, B. (1990): Jerdon's Courser – rediscovery and survey. Pp. 127-134. *In*: Anon: Status and ecology of the Lesser and Bengal Floricans with reports on Jerdon's Courser and Mountain Quail. Bombay Natural History Society.

BHUSHAN, B. (1995): Jerdon's Courser – status and conservation perspectives. Pp. 29-30. *In*: Vijayan, L. (Ed.): Avian conservation in India. Coimbatore. Sálim Ali Centre for Ornithology and Natural History.

BIRDLIFE INTERNATIONAL (2001): Threatened Birds of Asia: the BirdLife International Red Data Book. Cambridge, UK: BirdLife International.

CHAMPION, H.G. & S.K. SETH (1968): The revised survey of the forest types of India. Manager of Publications. Govt. of India. New Delhi. 404 pp.

GAGE, G.S., M. DE L.BROOKE, M.R.E. SYMONDS & D. WEGE (2004): Ecological correlates of the threat of extinction in Neotropical bird species. *Animal Conservation 7*: 161-168.

GASTON, K.J. (1994): Rarity. London: Chapman & Hall. pp. 1-192.

GOVERNMENT OF INDIA (2002): The National Wildlife Action Plan (2002 – 2016), Ministry of Environment and Forests. Pp. 1-46.

GOVERNMENT OF INDIA (2005): Seventeenth Indian livestock census - All India summary report: Livestock, Poultry Agricultural Machinery & Implements and Fishery Statistics – 2003. Downloaded from http://mospi.nic.in. Downloaded on October 13, 2006.

JAGANNADHA SARMA, V.V. (2002): Hydrology of Cuddapah district with special reference to its rainfall and tanks. Pp. 393-406. *In*: Proceedings of the National Seminar on Conservation of Eastern Ghats. EPTRI Envis, Hyderabad, India.

JEGANATHAN, P. & S.R. WOTTON (2004): The first recordings of call of the Jerdon's Courser *Rhinoptilus bitorquatus*. *J. Bombay Nat. Hist. Soc. 101(1)*: 26-28.

JEGANATHAN, P., R.E. GREEN, C.G.R. BOWDEN, K. NORRIS, D. PAIN & A.R. RAHMANI (2002): Use of tracking strips and automatic cameras for detecting critically endangered Jerdon's Coursers *Rhinoptilus bitorquatus* in scrub jungle in Andhra Pradesh. *Oryx 36(2)*: 182-188.

JEGANATHAN, P., R.E. GREEN, K. NORRIS, I.N. VOGIATZAKIS, A. BARTSCH, S.R. WOTTON, C.G.R. BOWDEN, G.H. GEOFFREY, D. PAIN & A.R. RAHMANI (2004a): Modelling habitat selection and distribution of the critically endangered Jerdon's courser *Rhinoptilus bitorquatus* in scrub jungle: an application of a new tracking method. *J. Appl. Ecol. 41(2)*: 224-237.

JEGANATHAN, P., A.R. RAHMANI, R.E. GREEN, K. NORRIS, C.G.R. BOWDEN, S.R. WOTTON & D. PAIN (2004b): Conservation of the critically endangered Jerdon's Courser *Rhinoptilus bitorquatus* in India. FinalReport, Bombay Natural History Society, Mumbai, India. Pp. 32.

JEGANATHAN, P., A.R. RAHMANI & R.E. GREEN (2005): Construction of Telugu-Ganga Canal in and around two protected areas in Cuddapah District, Andhra Pradesh, India. Immediate threat to the world population of the critically endangered Jerdon's Courser *Rhinoptilus bitorquatus*. Survey Report. Bombay Natural History Society, Mumbai, India. Pp. 19.

JEGANATHAN, P., R.E. GREEN, K. NORRIS, S.R. WOTTON, C.G.R. BOWDEN, D. PAIN & A.R. RAHMANI (2006): Conservation of the critically endangered Jerdon's Courser *Rhinoptilus bitorquatus* in India. Centenary Journal Proceedings. *J. Bombay Nat. Hist. Soc. 103 (2-3)*: 227-230.

NIKKU, B.R. (2004): "Water Rights, Conflicts and Collective Action: Case of Telugu Ganga Project, India." Paper Presented at "*The Commons in an Age of Global Transition: Challenges, Risks and Opportunities*," the Tenth Conference of the International Association for the Study of Common Property, Oaxaca, Mexico, August 9-13.

NORRIS, K. & N. HARPER (2004): Extinction processes in hot spots of avian biodiversity and the targeting of pre-emptive conservation action. Proceedings of the Royal Society of London. Series B. *271*: 123-130.

OWENS, I.P.F. & P.M. BENNETT (2000): Ecological basis of extinction risk in birds: habitat loss versus human persecution and introduced predators. *Proceedings of the National Academy of Sciences. USA*. 97: 12144-12148.

PURVIS, A., J.L. GITTLEMAN, G. COWLISHAW & G.M. MACE (2000): Predicting extinction risk in declining species. Proceedings of the Royal Society of London. Series B. 267: 1947-1952.

SENAPATHI, D., I.N. VOGIATZAKIS, P. JEGANATHAN, J.A. GILL, R.E. GREEN, C.G.R. BOWDEN, A.R. RAHMANI, D. PAIN & K. NORRIS (2007): Use of remote sensing to measure change in the extent of habitat for the critically endangered Jerdon's Courser *Rhinoptilus bitorquatus* in India. *Ibis 149*: 328-337.

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